ELECTROPHOTOGRAPHIC IMAGE FORMING APPARATUS, PROCESS CARTRIDGE AND DEVELOPING CARTRIDGE

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a process cartridge, and a development cartridge, employed by an electrophotographic image forming apparatus such as an electrophotographic copying machine, an electrophotographic printer, etc. It also relates to an electrophotographic image forming apparatus which employs such a process cartridge and a development cartridge.

Here, an electrophotographic image forming apparatus means an apparatus which forms an image on recording medium with the use of an electrophotographic image formation process. It includes, for example, various types of electrophotographic copying machines, electrophotographic printers (LED printers, laser beam printer, etc.), electrophotographic facsimileing machines, electrophotographic word processors, etc.

A process cartridge means a cartridge which integrally contains an electrophotographic photoconductive member as an image bearing member, and a minimum of a charging means, a developing means, a cleaning means, or an intermediary transferring means, and which is removably mountable in the main

assembly of an electrophotographic image forming apparatus.

A development cartridge means a cartridge which integrally contains a developing means for developing an electrostatic latent image formed on an electrophotographic photoconductive member, and a toner storage portion for holding toner, and which is removably mountable in the main assembly of an electrophotographic image forming apparatus.

A process cartridge system, in which an electrophotographic photoconductive member, and a single or plurality of means among a charging means, a developing means, a cleaning means, etc., are integrally disposed in a cartridge removably mountable in the image assembly of an electrophotographic image forming apparatus, has been employed quite a while.

A process cartridge system substantially improves an electrophotographic image forming apparatus in operational efficiency and convenience, and also makes it possible for a user him- or herself to maintain an electrophotographic photoconductive member, as well as processing means such as a charging member, a developing means, a cleaning means, etc. In other words, a process cartridge system makes it easy to maintain an electrophotographic image forming apparatus. Therefore, a process cartridge system has come to be widely used in the field of an image

forming apparatus.

In recent years, demands have increased for an electrophotographic color image forming apparatus capable of forming a color image. With this trend, it has been desired that the price of a color image forming apparatus substantially comes down, more specifically, it comes down lower enough for an average user to afford a color image forming apparatus of his or her own.

In order to make such a desire attainable, not only must a color image forming apparatus be substantially reduced in price, but also it must be further improved in operability, in consideration of the fact that it is used by an average user.

In order to accomplish at the same time two objectives, that is, cost reduction and operability improvement, it is necessary to further reduce a color image forming apparatus in size, and also to make sure that the apparatus can more easily supplied with consumables, and that paper jam or the like can be more easily to taken care of.

Thus, color image forming apparatuses equipped with a rotary type developing apparatus (rotational developing apparatus) having a rotary in which a plurality of development cartridges are mountable (Japanese Laid-open Patent Applications 7-121027, 10-221919, and 2000-231239) have been

proposed, and also, attempts have been made to commercialize the proposed apparatuses.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a development cartridge and a process cartridge, which are higher in the accuracy with which they are positioned relative to the main assembly of an electrophotographic image forming apparatus when mounted in the main assembly, and an electrophotographic image forming apparatus in which such development cartridge and process cartridge are removably mountable.

Another object of the present invention is to provide a development cartridge and a process cartridge, which can be reduced in size, and an electrophotographic image forming apparatus in which such development cartridge and process cartridge are removably mountable.

Another object of the present invention is to provide a development cartridge and a process cartridge, which are easily and reliably mountable in the main assembly of an electrophotographic image forming apparatus, and an electrophotographic image forming apparatus in which such development cartridge and process cartridge are removably mountable.

Another object of the present invention is to

provide a development cartridge, which is accurately and reliably positioned relative to the rotary rotatably attached to the main assembly of an electrophotographic image forming apparatus, and is capable of taking, regardless of rotary rotation, the development position in which an electrostatic latent image formed on the electrophotographic photo-conductive member can be developed by the developing means of one of the developments cartridges in the rotary, and the home position into which it retreats to move the development cartridge away from the development position, and an electrophotographic image forming apparatus in which such a development cartridge is removably mountable.

Another object of the present invention is to provide a development cartridge, the driving force input gear of which reliably engages with the driving gear of the main assembly of an electrophotographic image forming apparatus, and an electrophotographic image forming apparatus in which such a development cartridge is removably mountable.

Another object of the present invention is to provide a development cartridge, which is capable of improving the degree of accuracy with which an electrophotographic photoconductive drum and a developing means are positioned relative to each other, and an electrophotographic image forming

apparatus in which such a development cartridge is removably mountable.

Another object of the present invention is to provide a development cartridge, which is removably mountable in the main assembly of an electrophotographic image forming apparatus, and comprises: a frame; a developing means for developing an electrostatic latent image formed on an electrophotographic photoconductive member; a first projection, which projects from the frame, and engages with a first cartridge positioning portion of the main assembly to accurately position the development cartridge relative to the apparatus main assembly, when the development cartridge is mounted into the main assembly; a second projection, which projects from the frame, and engages with a second cartridge positioning portion of the main assembly to prevent the development cartridge from rotating about the first cartridge positioning portion, when the development cartridge is mounted into the main assembly; and a cartridge guiding member, which projects from the frame, guides the development cartridge by coming into contact with the cartridge guiding portion of the main assembly, when the development cartridge is mounted into the main assembly, and is pressed in the direction to be placed in contact with the second cartridge positioning

portion, when the development cartridge is mounted into the main assembly, and an electrophotographic image forming apparatus in which such a development cartridge is removably mountable.

Another object of the present invention is to provide a process cartridge cartridge, which is removably mountable in the main assembly of an electrophotographic image forming apparatus, and comprises: a frame; an electrophotographic photoconductive member; a developing means for developing an electrostatic latent image formed on an electrophotographic photoconductive member; a first projection, which projects from the frame, and engages with a first cartridge positioning portion of the main assembly to accurately position the process cartridge relative to the apparatus main assembly, when the process cartridge is mounted into the main assembly; a second projection, which projects from the frame, and engages with a second cartridge positioning portion of the main assembly to prevent the process cartridge from rotating about the first cartridge positioning portion, when the process cartridge is mounted into the main assembly; and a cartridge guiding member, which projects from the frame, guides the process cartridge by coming into contact with the cartridge guiding portion of the main assembly, when the process cartridge is mounted into the main assembly, and is

pressed in the direction to be placed in contact with the second cartridge positioning portion, when the process cartridge is mounted into the main assembly, and an electrophotographic image forming apparatus in which such a process cartridge is removably mountable.

Another object of the present invention is to provide an electrophotographic image forming apparatus, which is for forming an image on recording medium, and comprises: (i) a guiding portion; (ii) a first cartridge positioning portion; (iii) a second cartridge positioning portion; (iv) a cartridge mounting means for removably mounting a development cartridge, which is removably mountable in the main assembly of an electrophotographic image forming apparatus, and comprises: a frame; a developing means for developing an electrostatic latent image formed on an electrophotographic photoconductive member; a first projection, which projects from the frame, and engages with a first cartridge positioning portion of the main assembly to accurately position the development cartridge relative to the apparatus main assembly, when the development cartridge is mounted into the main assembly; a second projection, which projects from the frame, and engages with a second cartridge positioning portion of the main assembly to prevent the development cartridge from rotating about the

first cartridge positioning portion, when the development cartridge is mounted into the main assembly; and a cartridge guiding member, which projects from the frame, guides the development cartridge by coming into contact with the cartridge guiding portion of the main assembly, when the development cartridge is mounted into the main assembly, and is pressed in the direction to be placed in contact with the second cartridge positioning portion, when the development cartridge is mounted into the main assembly; and (v) conveying means for conveying the recording medium.

These and other objects, features, and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a vertical sectional view of the electrophotographic image forming apparatus in an embodiment of the present invention.

Figure 2 is a sectional view of the development cartridge.

Figure 3 is a perspective view of the development cartridge, as seen from the side from

which the development cartridge is driven.

Figure 4 is a perspective view of the development cartridge, for showing the movement of the slidable members of the development cartridge.

Figure 5 is a perspective view of the development cartridge, as seen from the side from which the development cartridge is not driven.

Figure 6 is a plan view of the development cartridge, as seen from the side from which it is driven.

Figure 7 is a plan view of the development cartridge and rotary, as seen from the side from which the development cartridge is driven, for showing the direction in which the development cartridge is inserted into the rotary.

Figure 8 is a plan view of the development cartridge and rotary, as seen from the side from which the development cartridge is driven, for showing the development cartridge in the rotary.

Figure 9 is a plan view of the development cartridge, as seen from the side from which it is not driven.

Figure 10 is a plan view of the development cartridge and rotary, as seen from the side from which the development cartridge is not driven, for showing the direction in which the development cartridge is inserted into the rotary.

Figure 11 is a plan view of the development cartridge and rotary, as seen from the side from which the development cartridge is not driven, for showing the development cartridge in the rotary.

Figure 12 is a perspective view of the rotary unit.

Figure 13 is a perspective view of the rotary, and a development cartridge which is being mounted into the rotary, for showing the direction in which the development cartridge is mounted into the rotary.

Figure 14 is a perspective view of the rotary, in which a development cartridge has been properly mounted.

Figure 15 is a perspective view of the control portion for controlling the pivotal movement of the rotary.

Figure 16 is a phantom side view of the development cartridge and rotary unit, for showing how the development cartridge is placed in contact with the photoconductive drum and is driven.

Figure 17 is a phantom side view of the development cartridge and rotary unit, for showing how the tips of the teeth of the driving force input gear of the development collide with their counterparts, and how the development cartridge is driven, when and after the development cartridge is orbitally moved to

the development position by the rotary unit.

Figure 18 is a phantom side view of the development cartridge and rotary unit, for showing how the driving force input gear of the development properly meshes with its counterpart, and how the development cartridge is normally driven, when and after the development cartridge is orbitally moved to the development position by the rotary unit.

Figure 19 is a sectional view of the rotary unit, the development roller of one of the development cartridges in which is in contact with the photoconductive drum.

Figure 20 is a sectional view of the rotary unit in the half distance position.

Figure 21 is a sectional view of the rotary unit in the full distance position.

Figure 22 is a vertical sectional view of an electrophotographic image forming apparatus, in accordance with the present invention, for showing how the development cartridge is mounted into, or dismounted from, the main assembly of the apparatus.

Figure 23 is a perspective view of a part of the rotary unit, for showing the locking mechanism for keeping the rotary locked in place.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the preferred embodiments of the

present invention will be described in more detail with reference to the appended drawings. In the following descriptions, however, the measurements, materials, and shapes of the structural components in the embodiments, their positional relationships, etc., are not intended to limit the scope of the present invention, unless specifically noted.

Further, in the following descriptions of the preferred embodiments, the front side means the upstream side in terms of the direction in which a recording medium is conveyed from the transferring station to the fixing station (right side in Figure 1), and the left or right side of the main assembly of an electrophotographic image forming apparatus means the left or right side as seen from the front side of the apparatus. Further, the lengthwise direction means the direction parallel to the axial direction of the development roller as a developing means.

{General Description of Image Forming Operation of Color Image Forming Apparatus}

First, referring to Figure 1, the general structure of a color image forming apparatus will be described.

Figure 1 is a vertical sectional view of a color laser beam printer, as an example of an electrophotographic color image forming apparatus in

accordance with the present invention, the main assembly of which is holding development cartridges, a drum cartridge, and an intermediary transfer member unit. It shows the general structure of the apparatus.

In this color image forming apparatus in Figure 1, an electrostatic latent image is formed on the electrophotographic photoconductive member (which hereinafter will be referred to as photoconductive drum 1), by projecting an optical image in accordance with image formation information, from an exposing means, and the electrostatic latent image is developed, with use of a developing means, into a developer image (which hereinafter may be referred to as toner image. In synchronism with the formation of the toner image, a recording medium (which hereinafter will be referred to as transfer medium) is conveyed to the transfer station, and also, the toner image formed on the photoconductive drum 1 is transferred onto the intermediary transfer belt 5a.

Then, the toner image on the intermediary transfer belt 5a is transferred onto the transfer medium by the second transferring means 11. Then, the transfer medium is conveyed to the fixing device 8 having a pressure roller 8a and heat roller 8b. In the fixing device 8, the toner image on the transfer medium is fixed. Then, the transfer medium is

discharged into a delivery tray 10.

Next, the image forming steps will be described in more detail.

In synchronism with the rotation of the intermediary transfer belt 5a, the photoconductive drum 1 is rotated in the direction (counterclockwise direction) indicated by an arrow mark in Figure 1. While the photoconductive drum 1 is rotated, the peripheral surface of the photoconductive drum 1 is uniformly charged by a charging apparatus 2. The uniformly charged portion of the peripheral surface of the photoconductive drum 1 is exposed by an exposing means 3; a beam of light modulated with the image formation information corresponding to the yellow component, for example, of an intended image, is projected onto the uniformly charged portion of the peripheral surface of the photoconductive drum 1. As a result, an electrostatic latent image corresponding to the yellow component is formed on the peripheral surface of the photoconductive drum 1.

More specifically, the uniformly charged portion of the peripheral surface of the photoconductive drum 1 is exposed by the exposing means in the following manner. The exposing means 3 projects a beam of light (optical image) modulated with the image formation information read in from an external apparatus or the like. The exposing means 3

comprises a laser diode, a polygon mirror, a scanner motor, a focusing lens, and a reflection mirror.

As image formation signals are given to the main assembly of an image forming apparatus from an external apparatus or the like, the laser diode emits light, as image formation light, in response to the image formation signals, and the light is projected onto the polygon mirror, which is being rotated at a high speed by a scanner motor. Thus, the light is reflected by the polygon mirror in a manner to be projected onto the peripheral surface of the photoconductive drum 1 by way of the focusing lens and reflection mirror. As a result, the numerous points of the uniformly charged portion of the peripheral surface of the photoconductive drum 1 are selectively exposed. Consequently, an electrostatic latent image is formed on the uniformly charged portion of the peripheral surface of the photo-conductive drum 1.

While the electrostatic latent image is formed, the developing device 4Y, that is, one of the development cartridges 4, is orbitally moved into the development position, and a predetermined bias voltage is applied to the development cartridge 4Y to develop the electrostatic latent image, that is, to adhere yellow toner to the electrostatic latent image.

Thereafter, a bias voltage, which is opposite

in polarity to the toner, is applied to a primary transfer roller 5j disposed in a manner to oppose the photoconductive drum 1, with the interposition of the intermediary transfer belt 5a between the photo-conductive drum 1 and transfer roller 5j. As a result, the yellow toner image on the photoconductive drum 1 is transferred (primary transfer) onto the intermediary transfer belt 5a.

As the primary transfer of the yellow toner image is completed as described above, the next developing devices is orbitally moved into the development position in which it is positioned in a manner to oppose the photoconductive drum 1. This process is also carried out for each of the cyan and black color components. As a result four toner images different in color are deposited in layers on the intermediary transfer belt 5a.

While the above described steps are carried out, the secondary transfer roller 11 is kept away from the intermediary transfer belt 5a, and so is the cleaning charge roller 5f as a cleaning unit.

Then, after the deposition of the four toner images different in color on the intermediary transfer belt 5a, the secondary transfer roller 11 is pressed upon the intermediary transfer belt 5a as shown in Figure 1. In addition, in synchronism with the pressing of the secondary transfer roller 11 on the

intermediary transfer belt 5a, the transfer medium kept on standby at a predetermined location in the adjacencies of the pair of registration rollers 7 as a conveying means, is sent into the nip between the intermediary transfer belt 5a and secondary transfer roller 11.

On the immediately upstream side of the pair of registration rollers 7, a preregistration sensor 14 is disposed, which keeps a transfer medium on standby at a predetermined location, by cutting off the force for rotationally driving the pair of registration rollers 7 as it detects the leading end of the transfer medium.

The secondary transfer roller 11 is supplied with a bias voltage which is opposite in polarity to toner. Thus, the toner images on the intermediary transfer belt 5a are transferred (secondary transfer) all at once onto the surface of the transfer medium which has been sent to the aforementioned nip and is being conveyed through the nip.

The transfer medium, which is bearing the transferred toner images, is conveyed to the fixing device 8 by way of the conveyance belt unit 12. In the fixing device 8, the toner images are fixed to the transfer medium. Then, the transfer medium is further conveyed by the pair of discharge rollers 13 along the discharge guide 15, and then, is discharged into the

delivery tray located at the top of the color image forming apparatus, by the pair of discharge rollers 9, concluding the image forming operation.

Meanwhile, after the completion of the secondary transfer, the cleaning charge roller 5f is pressed on the intermediary transfer belt 5a, and the residual charge on the surface of the intermediary transfer belt 5a, and the residual charge of the secondary residual toner, that is, the toner remaining on the intermediary transfer belt 5a after the secondary transfer, are removed by the application of a predetermined bias voltage.

The residual toner from which the residual charge has been removed is electrostatically transferred from the intermediary transfer belt 5a back onto the photoconductive drum 1 through the primary transfer nip; in other words, the surface of the intermediary transfer belt 5a is cleaned.

The secondary transfer residual toner having been transferred back onto the photoconductive drum 1 is removed by a cleaning blade 6 dedicated to the cleaning of the photoconductive drum 1, and is recovered.

The recovered residual toner, that is, waste toner, is conveyed through the waste toner conveyance path, which will be described later, to the waste toner box 216, and accumulated therein.

{Structure of Development Cartridge}

Referring to Figure 2, the development cartridge 4 is roughly dividable into a toner storage portion 302 and a development portion 309.

The toner storage portion 302 is filled with toner. As a stirring means 303 in the toner storage portion 302 is rotated, the toner is conveyed to the development portion 309 by a predetermined amount.

After being conveyed to the development portion 309, the toner is coated onto the peripheral surface of the development roller 305 as a developing means, by the rotation of a spongy toner supplying roller 304. Then, as the development roller 305 is further rotated, the body of toner on the peripheral surface of the development roller 305 is formed into a thin layer while being given electrical charge by the friction between the toner, and the combination of a development blade 332 in the form of a piece of thin plate and the development roller 305. As the development roller 305 is further rotated, the thin layer of toner on the development roller 305 is conveyed to the development position, in which the electrostatic latent image on the photoconductive drum 1 is developed (visualized) into a toner image by the application of a predetermined development bias.

The residual toner on the peripheral surface

of the development roller 305, that is, the toner which did not contribute to the visualization of the latent image on the photoconductive drum 1 and remained on the peripheral surface of the development roller 305, is stripped away by the toner supplying roller 304 while a fresh supply of toner is coated on the development roller 305 by the toner supply roller 304. In other words, the development operation is continually carried out.

Referring to Figure 9, the development cartridge 4 is provided with a first projection 352L, and a guiding rib 354 as a cartridge guiding member, which are on the external surface of the end wall of the development cartridge 4, on the side from which the development cartridge 4 is not driven. The guiding rib 354 is located next to the first projection 352L. The two are integral parts of the end wall. The development cartridge 4 is also provided with electrical contact portions A and B, which are on the top surface of the guiding rib 354, being therefore aligned in the direction parallel to the guiding rib 354.

The electrical contact portion A is the input portion through the development bias is applied to the development roller 305 and toner supplying roller 304, whereas the electrical contact portion B is the input portion through which bias is applied to the

development blade 332.

As described above, the electrical contact portions A and B are located near the positioning portion 352L of the development cartridge 4, minimizing thereby their positional deviation from the bias contact portions of the main assembly of the image forming apparatus, and therefore, assuring that they come into contact, and remain in contact, with their counterparts on the apparatus main assembly side. Further, since the electrical contact portions A and B in this embodiment are disposed on the top surface of the guiding rib 354 used when the development cartridge 4 is inserted, it is unnecessary for the electrical contact portions A and B to be protuberant from the cartridge wall, making it possible to minimize the cartridge size in terms of its lengthwise direction, which in turn makes it possible to reduce the size of the apparatus main assembly.

{Mounting and Dismounting of Cartridge}

Referring to Figure 22, as the top cover 64 of the apparatus main assembly is opened in the counterclockwise direction, an opening 65, through which cartridges are to be mounted into the apparatus main assembly, is exposed. All of the development cartridges 4 and the process cartridge 5 in this embodiment are made mountable or dismountable through

this opening 65.

Further, the apparatus main assembly is structured so that paper jam or the like problems can be dealt with by removing the process cartridge through this opening 65.

In other words, such chores as supplying the image forming apparatus with consumables, dealing with paper jam or the like problems, etc., can be done by opening only a single door (top cover 64), improving thereby the image forming apparatus in operability.

{Mounting, Dismounting, and Positioning of Development Cartridge}

Next, the mounting, dismounting, and positioning of the development cartridge will be described.

The development cartridges 4 holding the yellow, magenta, cyan, and black toners, one for one, are solidly mounted into predetermined positions, one for one, in a rotary 67 as a rotatable member. At this time, referring to Figures 3 - 14, and 22, the method for accurately positioning each development cartridge 4 relative to the rotary 67 will be described in detail.

Referring to Figures 13 and 22, the development cartridge 4 is mounted into the main assembly of the image forming apparatus by being

inserted straight into the apparatus main assembly in the direction indicated by an arrow mark, through the opening 65.

Referring to Figure 12, within the apparatus main assembly, a rotary unit 66 is disposed, which is rotatable about the central axle 51 thereof. The rotary unit 66 is provided with a pair of flanges 50L and 50R in the form of a disc, which are solidly attached to the lengthwise ends of the central axle 51, one for one.

The flange 50L is provided with: a cartridge guiding groove 50c, as the cartridge guiding portion of the apparatus main assembly side, which guides a development cartridge when the cartridge is mounted or dismounted; a first cartridge positioning portion 50aL as a primary referential portion, relative to which the development cartridge 4 is positioned; and a secondary cartridge positioning portion 50bL as a portion for controlling the rotation of the development cartridge 4 (Figure 10).

Similarly, the flange 50R is provided with: a cartridge guiding groove 50c, which guides a development cartridge when the cartridge is mounted or dismounted; a fourth cartridge positioning portion 50aR, also as a primary referential portion, relative to which the development cartridge 4 is positioned; and a third cartridge positioning portion 50bR as a

portion for controlling the rotation of the development cartridge 4 (Figure 7).

The bottom walls of the first and fourth cartridge positioning portions 50aL and 50aR are provided with a hole 50d for retaining the development cartridge. This hole 50d plays the role of a hole into which a projection of the development cartridge 4 engages to prevent the development cartridge 4 from falling out of the rotary 67.

In comparison, referring to Figure 9, the lengthwise end wall of the development cartridge 4, on the side from which the development cartridge 4 is not driven (which herein after will be referred to as non-driven side) is provided with: a guiding rib 354 which guides the development cartridge 4 when the development cartridge 4 is mounted or dismounted; a first projection 353L, as a primary referential portion, on the non-driven side, which is for accurately positioning the development cartridge 4 relative to the rotary 67, and is arcuate in cross section; and a second projection 353L, which is for controlling the rotation of the development cartridge 4, and is also arcuate in cross section.

Next, referring to Figure 6, the lengthwise end wall of the development cartridge 4, on the side from which the development cartridge 4 is driven (which hereinafter will be referred to as driven

side), is provided with: a guiding rib 354 which guides the development cartridge 4 when the development cartridge 4 is mounted or dismounted; a fourth projection 353R, as a primary referential portion, on the driven side, which is for accurately positioning the development cartridge 4 relative to the rotary 67, and is arcuate in cross section; and a third projection 353R, which is for controlling (retaining) the lengthwise end of the development cartridge 4, on the driven side, and is also arcuate in cross section.

The first and fourth projections 352L and 352R are aligned in the lengthwise direction of the development cartridge 4, and so are the second and third projections 353L and 353R. In other words, they are aligned in the direction parallel to the generator (or axial line) of the development roller 305.

Referring to Figures 7 and 10, the rotary 67 is provided with a pair of springs 53, as pressure applying members, which are for keeping the development cartridge 4 pressured in the direction to rotate in the counterclockwise direction of the drawing, and are attached to the flanges 50L and 50R, one for one, so that the functional parts of the springs 53 protrude into the corresponding cartridge guiding grooves 50C. In other words, each pressure applying member 53 keeps the cartridge pressured in

the direction opposite to the direction in which the rotary 67 is rotated.

Referring to Figures 8 and 11, the pressure N from the pressure applying springs 53 generate such a moment M, in the development cartridge 4, that causes the development cartridge 4 to pivot about the first and fourth projections 352L and 352R, causing thereby the second and third projections 353L and 353R of the development cartridge 4 to be placed, and kept, in contact with the second and third cartridge positioning portions 50bL and 50bR of the flanges 50L and 50R, respectively.

As the rotary 67 is rotated, the development cartridge 4 is subjected to centrifugal force which acts in the direction to eject the development cartridge 4 outward of the rotary 67. However, the retractable projections 380a and 380b, which will be described later, settle in the corresponding holes 50d. Therefore, the development cartridge 4 is pressured by the centrifugal force in the direction to pivot about the first and fourth projections 352L and 359R, in other words, in the direction to move the portions of the development cartridge 4 having the second and third projections 353L and 353R outward of the rotary 67 in terms of the radius direction of the rotary 67.

In this embodiment, however, the pair of

pressuring springs 53 are formed so that the amount of the pressure produced by the pair of pressuring springs 54 exceeds the amount of the above described centrifugal force. Therefore, even though the development cartridge 4 is repeatedly orbitally rotated and stopped, the development cartridge 4 is prevented from floating or being dislodged from the second and third cartridge positioning portions 50bL and 50bR.

With the provision of the above described structural arrangement, the position of the development cartridge 4 relative to the rotary 67 remains accurately fixed. Therefore, the development roller 305 of the development cartridge 4 is kept in contact with the photoconductive drum 1 of the process cartridge 5, while being kept parallel to the axial line of the photoconductive drum 1. In addition, it is possible to reduce the difference between the amount of the pressure to which the left side of the development cartridge 4 is subjected and the amount of the pressure to which the right side of the development cartridge 4 is subjected. Therefore, it is possible to reduce the difference in density, between the left and right sides of an image, resulting from the unbalance between the left and right side of the development cartridge 4 in terms of the pressure to which they are subjected.

Next, referring to Figure 11, the rotary 67 and development cartridge 4 are designed so that the second projection 353L on the external surface of the lengthwise end wall of the development cartridge 4, on the non-driven side, comes into contact with only one area of the cartridge contacting surface of the second cartridge positioning portion 50bL of the flange 50L. In terms of the radius direction of the rotary 67, this area of contact between the second projection 353L and second cartridge positioning portion 50bL is on the center side of the rotary 67 with respect to the center of the cartridge contact surface of the second cartridge positioning portion 50bL.

Referring to Figure 8, the third projection 353R of the driven side of the development cartridge 4 comes into contact with two areas of the cartridge contacting surface of the third cartridge positioning portion 50bR of the flange 50R. In terms of the radius direction of the rotary 67, one of the two contact areas between the third projection 353R and the third cartridge positioning portion 50bR is on the center side of the rotary 67 with respect to the center of the cartridge contact surface of the third cartridge positioning portion 50bR, and the other is on the outward side of the rotary 67. More specifically, the contact areas 353R-1 and 353R-2 of the cartridge positioning projection 353R of the

development cartridge 4 come into contact with the contact areas 50bR-1 and 50bR-2, respectively, of the third cartridge positioning portion 50bR of the flange 50R. This structural arrangement is made because, as the development cartridge 4 receives driving force, through its gear 307, from the apparatus main assembly, it is subjected to a force F which acts in the direction indicated by an arrow mark, as shown in Figure 16. In other words, the above described structural arrangement is made to assure that the development cartridge 4 is accurately positioned relative to the rotary 67 and remains therein.

The first and fourth projections 352L and 352R of the development cartridge 4 are the portions by which the development cartridge 4 is pivotally supported by the cartridge positioning portions of the rotary 67. The first projection 352L of the development cartridge 4 is made to exactly engage with the first cartridge positioning portion 50aL of the flange 50L, whereas the fourth projection 352R of the development cartridge 4 is made to engage with the forth cartridge positioning portion 50aR of the flange 50R, with the presence of a certain amount of gap.

Next, referring to Figures 3, 4, and 5, the development cartridge 4 is provided with a pair of retractable projections 380b and 380a, which are

extendable from, or retractable into, the first and fourth projections 352L and 352R, respectively.

These retractable projection 380b and 380a are integral parts of the left and right lengthwise ends, respectively, of a pair of slidable members 380, in the form of a rods, the length of which is roughly half the length of the development cartridge 4. Thus, the retractable projections 380b and 380a can be made to project from, or retracted into, the ends of the first and fourth projections 352L and 352R, respectively, by slidably moving the slidable members 380.

Further, the development cartridge 4 is provided with a hinge-like handle 381, which is attached the roughly center portion, in terms of the lengthwise direction, of the top portion of the development cartridge 4. The hinge-like handle 381 is kept pressured in the opening direction by an unshown torsion coil spring.

More specifically, the hinge-like handle 381 comprises the left and right members 381a and 381b, which are connected to the pair of slidable members 380, one for one. Thus, the slidable members 380 are slidably movable by rotationally moving the left and right members 381a and 381b of the hinge-like handle 381.

Normally, the left and right members of the

hinge-like handle 381 are kept apart by being pressured by the torsion coil spring, keeping thereby the retractable projection 380a, that is, the end portion of the slidable member 380, projecting from the end of the fourth projection 352R. However, as the hinge-like handle 381 is grasped, the left and right members thereof are rotationally moved, causing the retractable projection 380a, that is, the end portion of the slidable member 380 to retract into the fourth projection 352R.

Further, the left and right rotational members 381a and 381b of the hinge-like handle 381 are provided with a toothed portion, which is on the side opposite to the side on which the fingers are placed to rotationally move the left and right members 381a and 381b. The toothed portions of the left and right rotational members 381a and 381b are meshed with each other. Therefore, as one of the two rotational members 381a and 381b is rotationally moved, the other rotational member is rotationally moved by the rotational movement of the first rotational member. Thus, even if only one of the two rotational members 381a and 381b of the hinge-like handle 381 is rotationally moved, both of the slidable members 380 are reciprocally moved at the same time.

When inserting the development cartridge 4 into the rotary 67, first, the development cartridge 4

is to be grasped by the hinge-like handle 381, and then, the development cartridge 4 is to be inserted, with the pair of guiding ribs 354 of the development cartridge 4, which are on the external surfaces of the lengthwise end walls of the development cartridge 4, fitted in the cartridge guiding groove 50c of the flange 50L and the cartridge guiding groove 50c of the flange 50R, one for one.

Then, the hinge-like handle 381 is to be released from the fingers as the first and fourth projections 352L and 352R of the development cartridge 4, which are arcuate in cross section, come into contact with the first and fourth cartridge positioning portions 50aL and 50aR of the flange 50L and 50R, respectively.

Upon the release of the hinge-like handle 381, the retractable projections 380a and 380b project from the first and second projections 352L and 352R, respectively, and enter the aforementioned hole 50d of the bottom wall of the first cartridge positioning portion 50aL, and the hole 50d of the bottom wall of the fourth cartridge positioning portion 50aR, respectively.

The first projection 352L and retractable projection 380b are coaxial. Therefore, the development cartridge 4 is allowed to pivotally move about the axial line of the first projection 352L.

However, the cartridge pressuring springs 53 for keeping the development cartridge 4 pressured in the direction to rotate the development cartridge 4 in the counterclockwise direction of the drawing are partially projecting into the cartridge guiding grooves 50c, one for one. Therefore, the second and third projections 353L and 353R of the development cartridge 4 are kept in contact with the second and third cartridge positioning portions 50bL and 50bR of the flanges 50L and 50R, respectively. As a result, the development cartridge 4 is accurately positioned, and kept accurately positioned, relative to the rotary 67 (Figure 14).

On the other hand, in order to remove the development cartridge 4 from the rotary 67, first, the hinge-like handle 381 is to be grasped, as shown in Figure 4, to retract the retractable projections 380a and 380b so that they allow the development cartridge 4 to be removed upward from the rotary 67, by disengaging from the holes 50d.

As described above, the development cartridge 4 can be removed or mounted by the operation carried out by a user. Further, with the provision of the above described structural arrangement and method for solidly placing the development cartridge 4 in the rotary 67, the development cartridge 4 does not become disengaged from the rotary 67 while the rotary 67 is

rotated.

{Structure of Mechanism for Driving Development Cartridge}

Next, the structure of the mechanism for driving the development cartridge 4 will be described in detail.

Referring to Figure 12, the rotary flanges 50L and 50R are provided with a side plate 54, which is on the outward side of each rotary flange. The center axle 51 of the rotary 67 is disposed in a manner to penetrate the pair of flanges 50L and 50R, and the pair of side plates 54. More specifically, the rotary flanges 50L and 50R and the center axle 51 are rotationally supported by the side plates 54 so that the development cartridges 4 can be orbitally moved.

To one of the side plate 54, a gear train, that is, a set of gears meshed in a predetermined order, is attached. The driving force input gear 307 of the development cartridge 4, shown in Figure 16, meshes with the final gear, that is, the most downstream gear of the above described gear train on the side plate 54, and rotationally drives the development roller 305, coating roller, stirring members, etc.

In this embodiment, as the flanges 50L and 50R are rotated a predetermined angle, each

development cartridge 4 is orbitally moved the same angle. Further, as the development cartridge 4 is orbitally moved, the input gear 307 of the development cartridge 4 is engaged with the final gear 55 on one of the side plates 54 of the rotary 67.

{Development Cartridge Engagement by Rotary Rotation, and Driving of Development Cartridge}

It is possible that when the development cartridge 4 is orbitally moved into the development position by the rotation of the rotary 67, the teeth of the driving force input gear 307 of the development cartridge 4 collide with the teeth of the final gear 55 of the side plate 54 of the rotary 67, and fail to properly mesh. In this embodiment, however, the development cartridge 4 is allowed to temporarily pivot backward about the fourth cartridge positioning portion 50aR of the flange 50R. Therefore, it is assured that the teeth of the driving force input gear 307 properly mesh with those of the final gear 55 on the side plate 55.

To described in more detail, referring to Figure 17, when the input gear 307 of the development cartridge 4 is not in synchronism with the final gear 55 of the rotary 67 in terms of tooth position, the teeth of the former collide with those of the latter. As a result, the input gear 307 is subjected to the reactive force F from the collision, which acts in the

direction shown in Figure 17.

The vectors resulting from the reactive force F generate such a moment M that acts in the direction to pivotally move the development cartridge 4 about the first and third projections 352L and 352R in the counterclockwise direction. This moment M2 is greater than the moment M generated by the pressure N from the cartridge pressuring springs 53. Therefore, the development cartridge 4 is pressured in the direction indicated by an arrow mark B. In addition, the development cartridge 4 is pressured rightward of the drawing, by a force Fx, which is the x component of the reactive force F.

In this embodiment, however, the cartridge contacting portion 50bR-2 of the third cartridge positioning portions 50bR of the rotary 67, that is, the outward cartridge contacting portion of the rotary 67 in terms of the radius direction of the rotary 67, is roughly perpendicular to the line connecting the center of the fourth projections 352R, as the referential portion relative to which the development cartridge 4 is positioned, about which the development cartridge 4 is pivotally movable, and the center of the third projection 353R.

Therefore, the development cartridge 4 is allowed to pivotally move in the direction indicated by the arrow mark B; in other words, it is allowed to

escape outward. As a result, the condition in which the aforementioned collision between the teeth of the input gear 307 of the development cartridge 4 and the final gear 55 of the rotary 67 occurred is dissolved, allowing the two sets of teeth to mesh as shown in Figure 18.

Then, the development cartridge 4 is accurately positioned relative to the flanges 50L and 50R, in the predetermined manner, by the above described cartridge pressuring springs 53 of the flanges 50L and 50R, respectively.

As for the non-driven side of the development cartridge 4, the development cartridge 4 is allowed to pivotally move in the direction indicated by the arrow mark B about the first projection 352L as the referential portion for development cartridge positioning, about which the development cartridge 4 is pivotally movable. In other words, the non-driven side of the development cartridge 4 moves in the same manner as the driven side of the development cartridge 4 moves, which is needless to say.

After the completion of the driving of a given development cartridge, the development cartridge is orbitally moved out of the development position by the rotation of the rotary 67. However, the final gear 55 of the flange 50R sometimes fails to instantly disengage from the input gear 307 of the development

cartridge, when the development cartridge is moved out of the development position. Such a problem is also dissolved by the above described mechanism for allowing the development cartridge 4 to pivotally move; it is assured by the above described mechanism that the final gear 55 of the rotary 67 smoothly disengages from the input gear 307 of the development cartridge 4, allowing thereby the development cartridge 4 to be orbitally moved out of the development position.

The first and fourth projections 352L and 352R of the development cartridge 4 in this embodiment, about which the development cartridge 4 is pivotally movable, are located in the adjacencies of the downstream end of the development cartridge 4 in terms of the direction in which the development cartridge 4 is orbitally moved. However, as the input gear 307 of the development cartridge 4 collides with the final gear 55 of the rotary 67, the development cartridge 4 is pressured downward by the reactive force F resulting from the collision (Figure 18).

Thus, upon the collision, the first and fourth projections 352L and 352R of the development cartridge 4 are going to move downward. However, they are caught and supported by the first and fourth cartridge positioning portions 50aL and 50aR of the flange 50L and 50R, respectively. With the provision

of the above described supporting structure, even if the development cartridge 4 is orbitally moved at a high speed, it does not occur that the development cartridge 4 dislodge from the flange 50L and 50R due to the collision which occurs in the driving force inputting portion.

{Pressure Applied to Development Cartridge during Development Cartridge Engagement, and Driving of Development Cartridge}

Referring to Figure 16, as the input gear 307 of the development cartridge 4 is driven by the final gear 55 on the side plate 54 of the rotary 67, it is subjected to the force F resulting from the driving. In addition, the pressure N from the cartridge pressuring springs 53 act on the guiding rib 354, and therefore, a contact pressure W2 acts on the development roller 305. The combination of these three forces generate, in the development cartridge 4, such a moment M that acts in the direction to pivotally move the development cartridge 4 about the first cartridge positioning portion 50aL of the flange 50L in the counterclockwise direction of the drawing.

The development roller 305 rotates at a peripheral velocity roughly 150% greater than that of the photoconductive drum 1. In other words, the development roller 305 rotates roughly 1.5 times

faster than the photoconductive drum 1.

With the presence of this difference in peripheral velocity between the development roller 305 and photoconductive drum 1, the development roller 305 is subjected to a force P which acts in the tangential direction. Therefore, the development cartridge 4 is subjected to such a moment M2 that acts to pivotally move the development cartridge 4 about the first cartridge positioning portion 50aL of the flange 50L of the rotary 67, the counterclockwise direction of the drawing.

The clockwise moment M is substantially greater than the counterclockwise moment M2. Therefore, the second projection 353L of the development cartridge 4, that is, the projection on the non-driven side, is pressed on the second cartridge positioning portion 50bL of the flange 50L. Therefore, the development cartridge 4 is prevented from moving relative to the cartridge positioning point of the flange 50L, during the driving of the development cartridge 4.

Further, on the driven side of the development cartridge 4, the force F resulting from the driving of the gear 307 of the development cartridge 4 by the final gear 55 on the apparatus main assembly side acts on the driving force input shaft 308. Thus, the third projection 353R (et3R-1 and

353R-2) of the driven end of the development cartridge 4 is prevented by this force F from moving from the two contact portions, that is, the portions 50bR-1 and 50bR-2 of the third cartridge positioning portion 50bR.

In this embodiment, the third projection 353R of the development cartridge 4 is located on the downstream side of the force F which results from the driving of the driving force input gear 307 of the development cartridge 4 by the final gear 55 on the side plate 54 of the rotary 67 and acts on the driving force input shaft. Therefore, it is assured that the third projection 353R is firmly held by the third cartridge positioning portion 50bR of the flange 50R.

As described above, the development cartridge 4 is accurately positioned in the rotary 67, and firmly held therein. Therefore, the vibrations which are likely to occur due to the meshing of gears, in the driving force inputting portion, do not occur.

Incidentally, during a development operation, at the driven end of the development cartridge 4, the third projection 353R (353R-1 and 353R-2) functions as a positional reference, and the fourth projection 352R functions as a rotation controlling portion. Further, after the accurate positioning of the development cartridge 4 in the rotary 67, there remains a small

amount of play S (Figure 8) between the fourth projection 352R of the development cartridge 4 and the fourth cartridge positioning portion 50aR of the flange 50R, allowing thereby the fourth projection 352R, as the portion about which the development cartridge 4 is allow to pivotally move, to move slightly.

Therefore, the effects of the errors in component dimension can be absorbed by this play S, making it possible to prevent the development cartridge 4 from being mounted improperly in terms of its positional relationship relative to the rotary 67.

Also in this embodiment, the force for driving the development cartridge 4 begins to be transmitted to the development cartridge 4 before the development roller 305 comes into contact with the photoconductive drum 1. Therefore, the pre-rotation time for the development roller 305 can be secured without the need for lengthening the cartridge switching time.

The force F generated by the driving of the driving force input gear 307 by the final gear 55 on the side plate 54 of the rotary 67 is a part of the closed dynamic system confined within the rotary 67. Therefore, the force F has little effect upon the pressure applied to the photoconductive drum 1 by the

development cartridge 4, which will be described later.

Referring to Figure 18, as the development cartridge 4 is moved from a position in which the driving force input gear 307 of the development cartridge 4 is not engaged with its counterpart on the rotary side, and therefore, the development cartridge 4 is not driven, to the position in which the driving fore input gear 307 is engaged with its counterpart on the rotary side, and therefore, the development cartridge 4 is driven, the development cartridge 4 and the input gear 307 therein are subjected to the reactive force, which results from the engagement and driving of the development cartridge 4, and which acts in the normal rotational direction of the input gear 307. Incidentally, the rotational direction of the driving force input gear 307 of the development cartridge 4 in this embodiment is the same as the direction (counterclockwise direction) in which the development cartridge 4 is orbitally moved.

Therefore, as the development cartridge 4 is orbitally moved from the aforementioned pre-engagement position to the engagement position, in other words, as the input gear 307 comes into contact with the final gear 55 of the rotary 67, the development cartridge 4 and the input gear 307 therein are subjected to the reactive force F which acts in the

normal rotational direction of the input gear 307 shown in the drawing.

Since the reactive force F, to which the development cartridge 4 and its input gear 307 are subjected upon the engagement between the input gear 307 and final gear 55, acts in the normal rotational direction of the input gear 307, the development roller 305 is not rotated in reverse by the reactive force F. Therefore, it does not occur that the toner in the development cartridge 4 is conveyed backward by the reversal rotation of the development roller 305. Therefore, it does not occur that the sealing member 356 or the like, shown in Figure 2, is turned inside out by the reversal conveyance of the toner. Therefore, it does not occur upon the engagement between the input gear 307 and final gear 55 that the toner blows out of the development cartridge 4 due to the problem that the sealing member 356 or the like is turned inside out by the reversal conveyance of the toner, which is caused by the engagement.

{Structure of Mechanism for Applying Pressure on Development Cartridge}

In this embodiment, four development cartridges 4 different in the color of the toner contained therein are placed in the rotary 67, and each development cartridge 4 is kept pressed on the photoconductive drum 1 in the following manner.

Referring to Figures 12 and 16, the flanges 50L and 50R are rotatably supported by the side plates 54 of the rotary 67. More specifically, the side plates 54 are solidly attached to the shaft 60, which is rotatably supported by the side walls of the apparatus main assembly. In other words, the side plates 54 of the rotary 67 are accurately positioned relative to the apparatus main assembly by the shaft 60. Therefore, the development cartridges 4, flanges 50L and 50R, and side plates 54 of the rotary pivotally move together.

Thus, the development cartridge 4 is pressed upon, or moved away from, the photoconductive drum 1, by the pivotal movement of the combination of the development cartridges 4 and rotary 67.

This structure of making the development cartridge 4 and rotary 67 pivot in combination makes it possible to dispose the development cartridge pressing mechanism outside the rotary, instead of inside. Therefore it is possible to reduce the rotary 67 in size, and in addition, it is possible to simplify the mechanism for pressing the development cartridge.

The rotary 67 is pivotally moved by rotating the rotary pivoting cam 94, the axial line of which coincides with that of the rotational pressure application shaft 90. The rotary 67 can be set to two

positions, that is, the position in which the development roller 305 is kept in contacts the photoconductive drum 1 (Figure 19) and the position in which it does not place the development roller 305 in contact with the photoconductive drum 1 (Figure 21), by switching the rotational direction of the motor (unshown) for driving the cam 94.

Referring to Figure 15, the rotary pivoting cam 94 is attached to the shaft 90, and a flag 92 is attached to one end of the shaft 90. The direction in which the rotary pivoting cam 94 is rotating is detected by detecting the timing with which the flag 92 blocks the sensor 93 (Figure 14).

The development roller 305 of the development cartridge 4 is placed in contact with the photoconductive drum 1, by rotating forward the unshown cam driving motor for a predetermined length of time. With this forward rotation of the motor, the rotary pivoting cam 94 is rotated a predetermined angle, pressing thereby the tappet 99 downward (Figure 19).

As a result, the side plate 54 of the rotary 67 is rotated about the shaft 60 by the downward movement of the tapped 99, with the presence of a rotary pressing spring 98 between the tapped 99 and the side plate 54. Therefore, the rotary 67 is pushed (pivoted) toward the photoconductive drum 1.

In order to move the rotary 67 away from the photoconductive drum 1, the operation carried out to move the rotary 67 toward the photoconductive drum 1 is to be carried out in reverse; the unshown cam driving motor is to be rotated backward.

Incidentally, in this embodiment, the rotary 67 can be set to two positions, that is, the half and full distance positions, in which the development roller 305 of the development cartridge 4 does not contact the photoconductive drum 1. More specifically, when the rotary 67 is in the half distance position, the distance between the development roller 305 and photoconductive drum 1 is roughly 2mm (L/2 = 2 mm), whereas when the rotary 67 is in the full distance position, the distance between the development roller 305 and photoconductive drum 1 is roughly 4 mm (L = 4 mm).

In other words, the rotary 67 is allowed to take three different positions: the contact position shown in Figure 19; half distance position shown in Figure 20, and full distance position shown in Figure 21. The rotary 67 is placed in these three positions by rotating the unshown cam driving motor forward or backward so that the rotary pivoting cam 94 rotates 0°, 90°, or 180°.

Also in this embodiment, during an actual image forming operation, the rotary 67 is pivotally

moved only between the contact position, and the half distance position in which the rotary 67 is rotated. The full distance position is used only to remove the development cartridge 4, or to read, or write into, the memory tag of the development cartridge 4.

When the rotary 67 is pivotally moved toward the photoconductive drum 1 from the half distance position to place the development roller 305 of the development cartridge 4 in contact with the photoconductive drum 1, the distance the rotary 67 travels is substantially shorter (half) than that when the rotary 67 is pivotally moved toward the photoconductive drum 1 from the full distance position to place the development roller 305 of the development cartridge 4 in contact with the photoconductive drum 1. Therefore, the amount of the shock and operational noises which the photoconductive drum 1 is subjected when the rotary 67 is moved from the half distance position is half the shock and operational noises to which the photoconductive drum is subjected when the rotary 67 is moved from the full distance position.

As described previously, the development cartridge 4 is positioned relative to the rotary 67 at a total of four portions, that is, two portions at the left end and two portion at the right end.

Referring to Figure 3, designated by a referential letter h is the line connecting the axial

lines of the first and fourth projections 352L and 352R as the positioning portions, and designated by a referential letter p is the line connecting the axial lines of the second and third projections 353L and 353R. Further, designated by a referential letter v is the generator (which is parallel to axial line) of the development roller 305. In this embodiment, the development cartridge 4 is structured so that the lines h and p become parallel to the generator v.

Further, the development roller 305 is disposed so that its axial line is placed between the lines h and p. Therefore, the contact pressure w which occurs between the development roller 305 and photoconductive drum 1 can be evenly borne by the four projections, preventing thereby the development cartridge 4 from being twisted. Therefore, it does not occur that one side of the development roller 305 is pressed harder on the photoconductive drum 1 than the other side.

{Control of Rotary Rotation}

Referring to Figure 12, the peripheral portions of the flanges 50L and 50R are in the form of a gear, and the rotary unit 66 is provided with a pair of follower gear 59, which are disposed at the lengthwise ends, one for one, and are engaged with the gear portions of the flanges 50L and 50R, one for one. The pair of follower gears 59 are connected by the

rotational axle. Thus, one of the rotary flanges, for example the flange 50R, rotates, the other flange, that is, the flange 50L, is rotated in the same phase through the pair of follower gears 59.

With the provision of this driving structure, it is prevented that one of the flanges 50L and 50R is twisted while the flanges 50L and 50R are rotated to orbitally move the development cartridge 4, or while the development cartridge 4 is driven.

The shaft 60 about which the side plates 54 are pivotally moved is provided with a rotary driving gear 59, which rotates the flanges 50R. This rotary driving gear 59 is connected to the rotary driving motor 61.

To the end of the rotational axle of the rotary driving motor 61, an encoder 62 of a known type is attached. The amount of the rotation of the rotary driving motor 61 is detected by this encoder 62 to control the revolution of the motor 61.

The flange 50L is provided with a flag 57, which perpendicularly projects inward from the peripheral portion of the flange 50L. This flag 57 passes a photo-interrupter 58 fixed to the side plate 54, as shown in Figure 16, as the rotary 67 is rotated.

In this embodiment, the rotation of the rotary 67 for orbitally moving the development

cartridges 4 is controlled so that the rotary 67 is rotated a predetermined angle with reference to the moment the flag 57 blocks the photo-interrupter 58. The rotational angle of the rotary 67 is detected from the revolution of the motor 61 detected by the aforementioned encoder 62. It has been a common practice to control the rotation of the rotary 67 with the use of a pulse motor or the like. In this embodiment, however, a DC motor is employed to rotate the rotary 67, more quietly driving the rotary 67.

It is possible that the development cartridge 4 is displaced from the development position by the unexpected rotation of the rotary 67 caused by the driving of the development cartridge 4. Therefore, the rotary 67 must be locked in place in terms of rotation so that it does not rotate.

It is possible to electrically brake the DC motor as the rotary driving motor, in order to lock the rotary 67 in terms of rotation. However, there is the possibility that braking the DC motor for a long time increases the temperature of the DC motor, which might result in the burnout of the coil in the motor.

In this embodiment, therefore, the rotational axle of the follower gear 59 is provided with a locking groove 95, as shown in Figure 23. Thus, each time the development cartridge 4 arrives at the

predetermined position (development position), the claw of a stopper 96 is inserted into the locking groove 95.

The stopper 96 is moved up or down by turning on or off a solenoid 97 with a predetermined timing. In other words, in this embodiment, a mechanical locking mechanism is employed to prevent the rotary 67 from unexpectedly rotating.

The above described embodiment of the present invention has the effects which will be described next.

(1) It is assured that the development cartridge 4 is accurately positioned relative to the rotary 67, and that the rotation of the rotary 67 is stable. Therefore, it is possible to always print an excellent image.

(2) It is assured that the input gear 307 of the development cartridge 4 properly meshes with its counterpart, eliminating thereby the problem that the development roller 305 erratically rotates. Therefore, an excellent image can be formed.

(3) If the input gear 307 of the development cartridge 4 fails to properly mesh with the final gear 55 of the rotary 67 immediately after the development cartridge 4 is orbitally moved to its designated position, the development cartridge 4 itself is allowed to temporarily and pivotally retract to assure

that the input gear 307 properly meshes with the final gear 55. Therefore, the formation of an abnormal image, or printing errors, can be prevented.

(4) The development cartridge 4 is moved in combination with the rotary 67, toward, or away from, the photoconductive drum 1, eliminating the need for a complicated mechanism for individually moving the development cartridge 4. Therefore, it is possible to reduce image formation apparatus cost.

(5) It is possible to begin driving the development cartridge 4 before the development roller 305 of the development cartridge 4 comes into contact with the photoconductive drum 1. Therefore, it is possible to increase image formation speed.

As is evident from the above description of the embodiment of the present invention, not only does the present invention make it possible to reduce image forming apparatus cost, but also the embodiment makes it possible to improve image forming apparatus in operability. Further, the embodiment makes it possible to increase image formation speed.

As described above, the effects of the present invention are as follows. That is, it is possible to increase the degree of accuracy with which a development cartridge and a process cartridge are attached to the main assembly of an electrophotographic image forming apparatus, and it is possible to

reduce in size a development cartridge, a process cartridge, and an electrophotographic image forming apparatus in which such development cartridge and process cartridge are removably mountable. Further, it is possible to more easily and more reliably mount a development cartridge and a process cartridge into the main assembly of an electrophotographic image forming apparatus.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth, and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.